TECHNICAL ASSESSMENT DOCUMENT

Further Study Measure 11 (FS-11)
Regulation 8, Rules 44 and 46
Marine Loading Operations

December 2002

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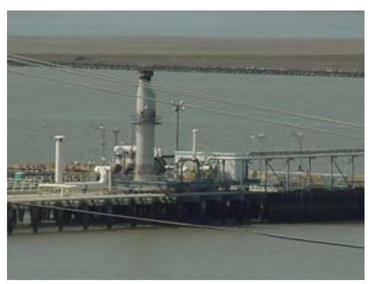

Reviewed by:
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I. EXECUTIVE SUMMARY

The Bay Area 2001 Ozone Attainment Plan contains commitments for further study to determine if additional emission reductions could be achieved and whether implementation of additional control measures is feasible. If the further study indicates a control measure is feasible and yields significant emission reductions, the further study as a control measure may be adopted and implemented prior to the 2004 SIP revision; incorporated into the 2004 SIP revision; or added to the control strategy in subsequent plan revisions.

A. Scope of Technical Assessment

The Bay Area Air Quality Management District (BAAQMD or District) has the lead for Further Study Measure 11, which examines potential emission reductions from loading activities at marine terminals and between ships (lightering). In addition, potential emission reductions from ballasting and housekeeping operations were examined. Participation in this study included the California Air Resources Board (ARB), the Environmental Protection Agency (EPA), affected industry, and the public.

B. Findings

Based on this assessment, staff finds:

- Emissions from large loading events or series of loading events of currently unregulated cargos can be significant. Non-methane hydrocarbon (NMHC) emissions from one unregulated cargo, such as high sulfur fuel oil, can be as high as 0.6 tons when loading 250,000 barrels. Assuming the current standard of 2 pounds per thousand barrels does not change, 0.35 tons are subject to control. If the standard were lowered to one pound per thousand barrels, 0.5 ton of NMHC emissions are subject to control. If a series of loading events were being performed on a predicted ozone excess day, the emissions would be significant.
- Expanding the regulations to cover additional cargos would also reduce the emissions from aromatic compounds such as benzene, toluene, and xylene.
- Corrections to the emissions inventory are necessary to better reflect emissions from currently unregulated cargos.
- Additional testing would be required to define emission factors for each category.
- Cargos referred to as fuel oil have been found to have emission factors above and below the current standard. Specifications for these cargos vary significantly.
- More information is necessary to characterize economic impacts such as operating expenses, fees, and possible capital expenditures.

1. Emission Inventory

Figure 1 shows the total emissions from marine loading at all terminals from September 2000 to August 2001. The data is separated into three categories, light, medium, and heavy cargos. The following table shows the material and the associated category. These categories do not necessarily correlate with an associated emission factor.

Light Cargo	Medium Cargo	Heavy Cargo
Gasoline	Jet fuel	Fuel oil
Crude oil	Diesel oil	Bunker oil
Aviation gas & aviation fuel (JP-4)	Cutter stock	Lube oil
Gasoline blending stock	Alkane	Charge stock
Naphtha	Kerosene	Cat Cracker Feed
Ortho-Benzene	Diesel blending stock	Gas oil
	Light Cycle Oil	Black oil
		Residual oil
		Polymers

There were two errors found in the current District emissions inventory. The inventory assumes all loading events are controlled to 95% efficiency. The emission factors for currently unregulated cargos are not consistent with test results.

2. Potential Control Strategies

Based on this assessment, equipment control strategies would be the likely method of controlling emissions. Equipment control strategies are those that require the installation of new equipment or devices, or can include physical changes to the piping system. Potential engineering control strategies applicable for marine loading operations include vapor balance, refrigeration, carbon adsorption, incineration, or a combination of technologies.

3. Cost and Cost-Effectiveness

The costs of Equipment Control Strategies vary depending on available capacity of current equipment and type of any additional control equipment selected to comply with emission requirements. Vapor balance and refrigeration strategies recover organic vapors. Carbon adsorption requires handling of spent carbon beds and incineration strategies require fuel for combustion.

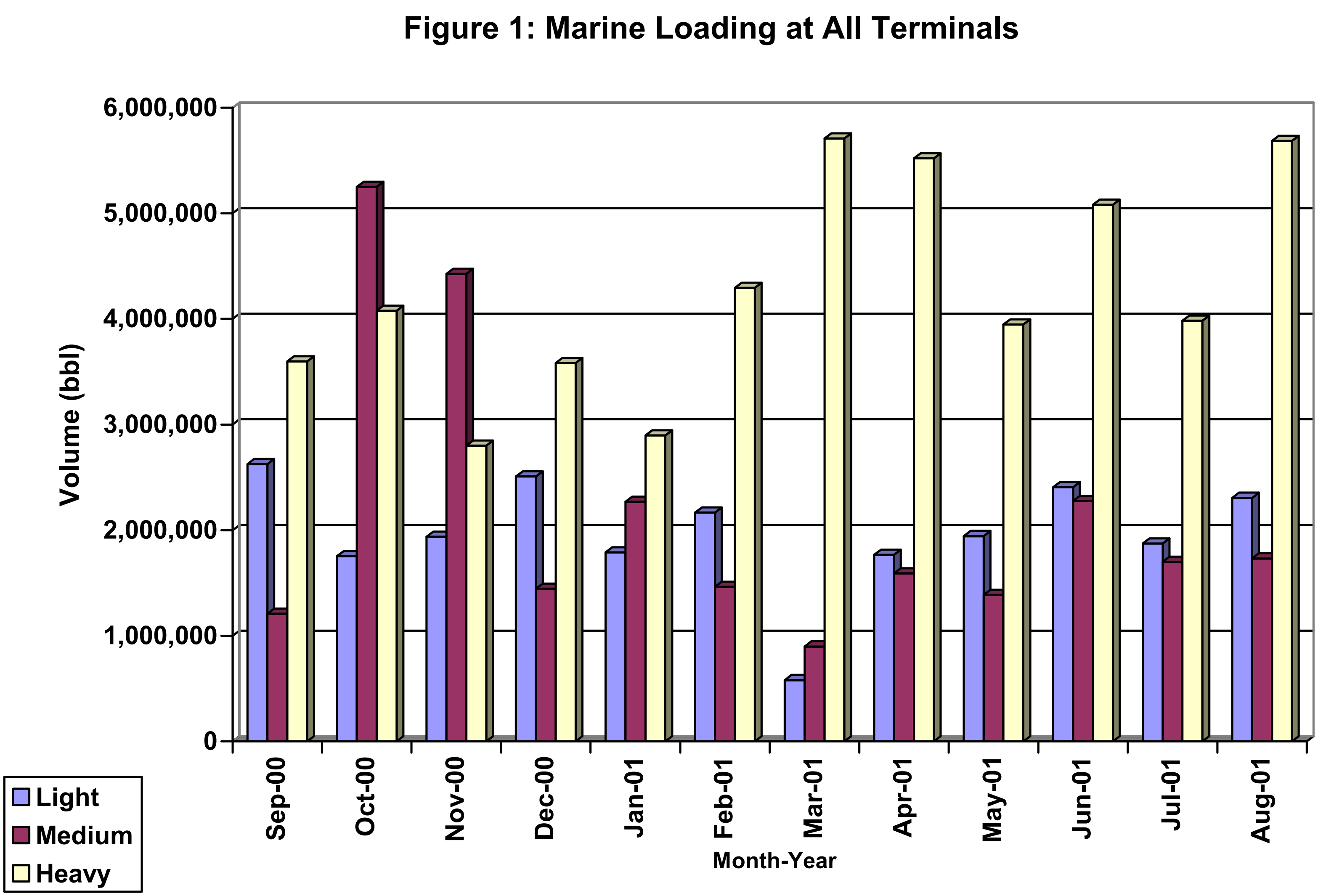


Figure 1: Marine Loading at All Terminals
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Volume (bbl)
Sep-00
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Jun-01
Jul-01
Aug-01
Month-Year
Light
Medium
Heavy

II. RECOMMENDATIONS

Based on this assessment, staff recommends:

A. Changes to Emission Inventory

Correct the District emissions inventory to reflect actual emissions from currently unregulated cargos.

B. Control Measure Development

Expand Regulation 8, Rule 44 and Regulation 8, Rule 46 to include all cargos that emit above the set standard. Develop a method to easily determine applicability and compliance. Consider different emission standard depending upon the type of marine vapor control equipment being used.

Lower the emission standard for vapor tight to 1,000 ppmv to be consistent with other adopted rules and clarify the definition of vapor tight in the definition table to "1 centimeter or less" as defined at the interface.

Require the emissions from the ballasting into non-segregated tanks, which previously held a regulated cargo to be controlled at all times.

Include a notification process for terminal loading and lightering activities. Include parametric monitoring requirements when appropriate. Revise and enhance recordkeeping requirements to a District-approved format.

C. Areas for Further Study

Additional information on operating costs of marine vapor recovery equipment is necessary. Fees and expenses incurred by vessels are needed. An emission versus cost for small volume loads should be studied.

Additional information on procedures and frequency of housekeeping activities is needed to better characterize emissions.

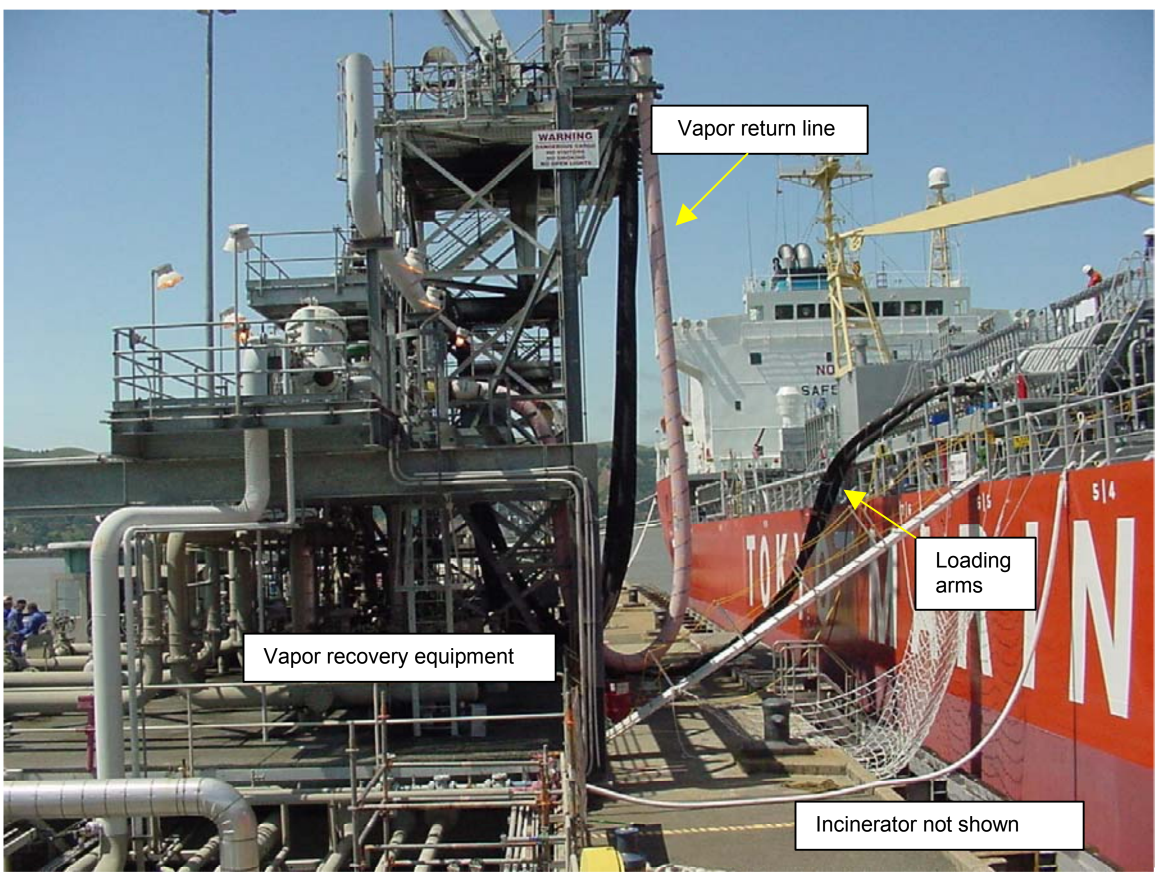
III. INTRODUCTION

A. Background

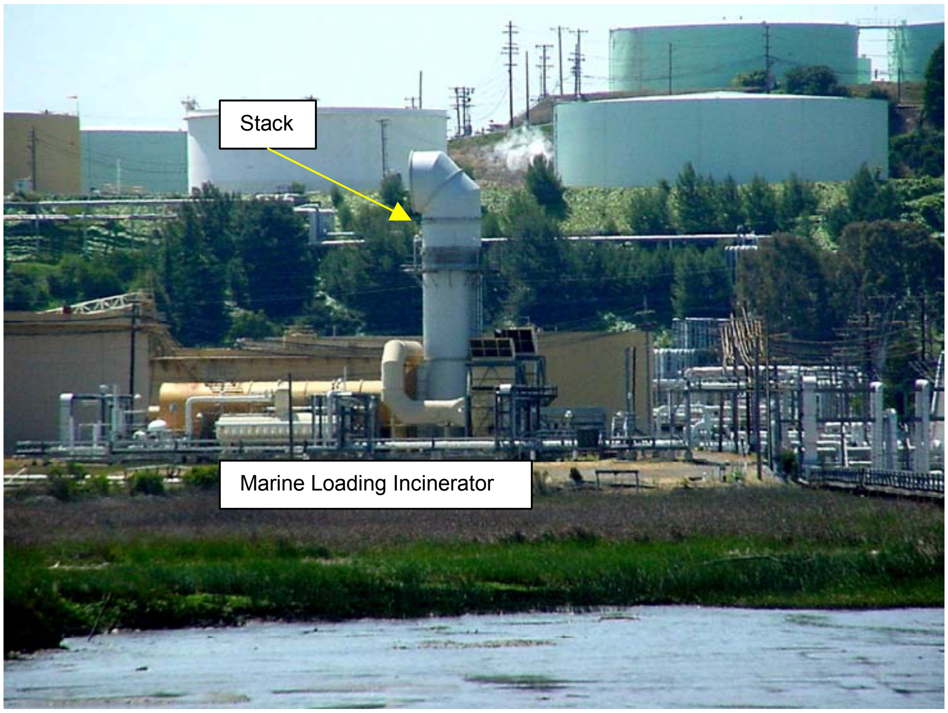
The Bay Area 2001 Ozone Attainment Plan is the strategy for the San Francisco Area air basin to achieve compliance with the 1-hour National Ozone Standard. Included in the 2001 Bay Area Ozone Attainment Plan, Further Study Measure 11 examines potential emissions reductions for marine loading activities by enhancing enforcement, requiring additional controls, and or expanding the applicability of the rule. In addition, potential emissions reductions from ballasting and housekeeping operations, such as venting, purging, and gas freeing, are being considered.

Volatile organic compound (VOC) emissions from marine vessels are generated when organic liquids are loaded into the vessel's cargo tank from either a terminal or another marine vessel. As the cargo is loaded into the tank, VOC vapors are created in the headspace, in addition to any vapors from previous loading events. The liquid displaces these vapors from the cargo tank into the atmosphere when the loading is uncontrolled.

The following is a picture of a vessel loading an unregulated cargo.



The vapor recovery hose is not connected to the vapor return line on the ship. The vapor recovery equipment is located to the left of the vessel. The incinerator for this process is in the following picture.



B. Existing Regulations

Regulation 8, Rule 44 limits organic emissions from loading operations at marine terminals. The rule affects mostly petroleum refineries, chemical plants and bulk terminal distribution facilities. The rule was originally adopted in 1989 and has never been amended. Regulation 8-46 applies to marine vessel to marine vessel loading operations. The rule was originally adopted in 1989 and has never been amended. Regulation 8, Rule 44 and Rule 46, currently requires control for loading of specified cargoes such as gasoline, gasoline blending stocks, aviation gas, JP-4 aviation fuel, and crude oil. The standard for these rules is 2 pounds of precursor organic compound (POC) emissions per thousand barrels of organic liquid loaded or 95% reduction of POC emissions.

Several technologies are available to control emission from marine loading operations. Examples are vapor balance, refrigeration/condensation, carbon adsorption, incineration, or a combination of these methods. Vapor recovery equipment can be located at the marine terminal or onboard the shipping vessels.

On July 19, 1991, the South Coast Air Quality Management District (SCAQMD) adopted Rule 1142 for Marine Loading Operations. The San Luis Obispo County

Air Pollution Control District (SLOCAPCD) adopted a Marine Tanker Loading rule, Rule 427, on April 26, 1995. The Santa Barbara County Air Pollution Control District (SBCAPCD) marine tanker loading regulation is Rule 327. These air districts have one rule for marine loading activities at terminals and lightering. The following table is a comparison of the regulations.

Regulation & Year Last Modified	Applicable Cargos	Loading Standard or Efficiency	Vapor Tight Standard	House-keeping & ballasting
BAAQMD Reg. 8-44 & 8-46 (1989)	Gasoline, gasoline blending stocks, aviation gas, aviation fuel, crude oil	2.0 lb/1000 bbl or 95% reduction	10,000 ppmv	No standard for housekeeping. Control for ballasting into tanks whose prior cargo was regulated.
SCAQMD Rule 1142 (1991)	All cargos	2.0 lb/1000 bbl or 95% reduction	1,000 ppmv	Yes for both
SLOCAPCD Rule 427 (1995)	Gasoline, gasoline blending stocks, aviation gas, aviation fuel, intermediate petroleum distillates, crude oil	2.0 lb/1000 bbl or 95% reduction w/o combustion control or 98% with combustion control	1,000 ppmv	Yes for both
SBCAPCD Rule 327 (1985)	Including but not limited to petroleum residuum, petroleum distillates, crude oil	3.1 lb/1000 bbl or 95% reduction	No standard	No standard

The SCAQMD and SBCAPCD marine loading regulations are not cargo specific, but standard driven.

IV. SUPPORTING DATA AND DISCUSSION

A. Inventory

Staff received loading records of unregulated cargos from the refinery terminals and lightering operations covering August 1999 to August 2001. Records from non-refinery terminals were received covering periods from September 2000 to August 2002. Since data from refinery and non-refinery terminals covered different time periods, Figure 1 reflects a 12-month period that overlapped for all terminals. The amount loaded was separated into three categories, light, medium, and heavy cargos. As shown from test data and outside emission reports, these categories do not necessarily correlate with an associated emissions factor.

Light Cargo	Medium Cargo	Heavy Cargo
Gasoline	Jet fuel	Fuel oil
Crude oil	Diesel oil	Bunker oil
Aviation gas & aviation fuel (JP-4)	Cutter stock	Lube oil
Gasoline blending stock	Alkane	Charge stock
Naphtha	Kerosene	Cat Cracker Feed
Ortho-Benzene	Diesel blending stock	Gas oil
	Light Cycle Oil	Black oil
		Residual oil
		Polymers

When regulated and unregulated liquids are loaded onto the same vessel, one refinery terminal controls all cargos loaded into that vessel.

The current District emissions inventory is based on the assumption that all loading events are controlled to 95% efficiency, which is not the current practice for uncontrolled cargos. Based on the results of this assessment, the emission factors need to be updated. For example, fuel oil, the largest uncontrolled cargo has an emission factor between 1.4 and 4.7 pounds per thousand barrels loaded. The current inventory effectively uses 0.000125 pounds per thousand barrels.

B. Testing

The District began testing unregulated cargos in November 2001. A testing protocol and checklist were developed to standardize procedures (See Appendix). The testing consists of continuous sampling preferably for the entire loading event. The protocol incorporates procedures for splitting samples with the ARB. Samples were split with ARB for the May 22, 2002 and June 11, 2002 tests. The following is a summary of five loading events tested by staff.

Test Date	Material	Loaded, barrels	NMHC Emission Factor, lbs/1000 bbl	Prior Cargo	Load Temp	Flash Point	Ambient Temp	House-keeping	Inerted ?
11/1& 11/2/01	Flash Distillate Oil[8]	157,968	District result 2.1	NA	153°F	NA	NA	NA	Yes
5/22/02	Diesel Oil[9]	1,000	District result 2.0 ARB result 2.0	Diesel	82°F	125 to 180°F	75°F	NA	No
6/11/02	Fuel Oil #6[11]	10,327	District result 1.4 ARB result 1.6	Fuel Oil #6	171°F	>150°F	61°F	None	No
6/18/02	High Sulfur Fuel Oil[12], 2.95 wt% S	110,063	District result 4.7	Fuel Oil	125°F	202°F	74°F	None	Yes
10/22/02	JP-8 Jet Fuel[13]	17,370	District result 1.1 to 2.2	JP-8 Jet Fuel	63°F	150°F	NA	NA	Yes

NA = not available

Ambient temperature was noted at the start of the test.

With the exception of the October 22, 2002 test, the continuous sampling results showed little variation of NMHC emissions during test.

In conjunction with continuous sampling, evacuated cylinders were used so that the vent gas contents could be analyzed. The results of the canister samples show that the vent gases contained notable levels of light-end hydrocarbons and cyclical aromatic compounds such as benzene, toluene, and xylene were indicated. The table below shows the concentration levels from the evacuated cylinders and grab samples. BTEX concentration is the cumulative concentration of benzene, toluene, ethylbenzene, p/m xylene, and o-xylene.

Date of Test	Tank #	Hydrocarbons less than C5, ppm as C1	BTEX Concentration, ppm as C1
11/1/01	ST-447	1350	1870
11/1/01	ST-436*	1110	1770
11/1/01	ST-435	1840	1450
11/1/01	ST-438*	2420	1330
11/1/01	ST-417	2610	1240
11/1/01	ST-434*	1410	1610
6/11/02	ST-408	360	520
6/11/02	ST-414	540	330
6/18/02	ST-449	7400	1530
6/18/02	ST-450	7940	1430
6/18/02	ST-451	9100	1600
6/18/02	ST-407	9100	1530
10/22/02	ST-408	2650	150
10/22/02	ST-413	2391	150
10/22/02	ST-449	459	61

* Grab sample

There are eleven (11) marine terminals that operate in the Bay Area. The District tested eight terminals to determine control efficiencies and emission factors. The results are summarized in the following table.

Site	Test Dates	Load	Emission Factor, lb/1000 bbl	Abatement Efficiency, %	Abatement Type	Total Liquid Loaded, barrels
1	4/20/92 to 4/21/92	MTBE	0.098	99.7	Adsorption	75,394
2*	4/13/92	Gasoline	2.33	97.8	Adsorption	100,111
3	11/15/91	Gasoline	<0.83	>97.4	Incineration	40,417
4	7/6/92	Gasoline	<0.035	>99.9	Incineration	38,432
5	4/27/93 to 4/28/93	Gasoline	0.02	99.8	Incineration	8,623
6	4/23/92 to 4/24/92	SJV Crude	0.2	97.4	Adsorption	34,451
7	12/5/91 to 12/7/91	Gasoline	<0.14	>99.9	Incineration	104,451
8	12/17/91 to 12/19/91	Gasoline	<0.22	>98.6	Incineration	263,819

* Abatement system maintenance problems occurred during test.

The effect of the abatement system maintenance problems at Site 2 on the emission factor or abatement efficiency was not determined.

C. Other Test Results

Test results from outside organizations and marine loading regulations from other air districts were researched. A summary of the results is shown in the following table.

Test Date	Material	Total Loaded, barrels	NMHC Emission Factor, lbs/1000 bbl	Prior Cargo	House-keeping	Inert System
1977 to 1978	Water (ballasting)	Various	17 to 180	Crude oil	NA	NA
5/11/93	#2 Diesel	2,047	1.9	#2 Diesel	None	NA
7/11/93 & 7/12/93	CARB Diesel	44,329	1.8 to 2.9	Jet A	none	NA
2/5/94 & 2/6/94	Unhydrofined Fluidized Catalytic Cracker Stock	261,000	4.2	SJV Crude	Diesel oil wash	Yes
5/9/95	Light Cycle Oil	27,133	24.6 to 34.1	cleaned	Water wash	NA
10/9/01	Cutter Stock (Taylor Katalytic DeNitrification, TKN)	≈ 30,000	4.7 as VOC, unabated	High Sulfur Fuel Oil	NA	NA
6/17/02	EPA diesel	750	1.07	EPA diesel	NA	NA

The 1977 EPA study examined 22 events of ballast water being loaded into tanks, which previously held crude oil. Today, most ballasting occurs in segregated water tanks in newer vessels. In certain situations, a vessel may require additional ballasting capacity than what is available in the segregated tanks. The tanks that held organic equipment would then be used. The number of vessels operating in the Bay Area that do not have segregated ballast tanks has not been determined. Recently submitted records do not indicate that ballasting into non-segregated tanks, which previously held a regulated cargo is a being performed at the terminal. During certain sea conditions, additional ballasting into these non-segregated tanks may be required. Additional study on this practice is needed.

The emissions inventory shows that crude oil is the only product currently being lightered in the Bay Area.

The October 9, 2001 test used SCAQMD Test Method 25.1. The emissions were routed to activated carbon system with virgin carbon stock. The VOC emissions were tested before and after the carbon system. The abated VOC emission factor was calculated at 0.03 pounds per thousand barrels. [14]

D. Other Reports

After crude oil has been distilled, the light ends are separated for further processing leaving the heavy ends of residual oil. In order to meet the specifications for No. 6 fuel oil, this residual oil is blended with lighter oils to meet API gravity, pour point and viscosity.[6]

A Material Safety Data Sheet for No. 6 fuel oil shows a flash point greater than 150 °F. Although flammable vapor production is expected to be minimal unless the fuel oil is heated above its flash point, industry practice indicates that light hydrocarbon vapors can build up in the headspace of storage tanks at temperatures below the flash point of the oil.[7]

According to the Oil Companies International Marine Forum, there is no direct relationship between the flash point of residual fuel oil and headspace flammability because of light hydrocarbon production even at ambient temperatures.[2]

E. Enforcement Practices

Inspections at marine terminal are scheduled in advance because there is no notification requirement in the current regulation. Previously, lightering in the Bay Area was performed by a few shipping companies. Presently, lightering is conducted by many companies, making it difficult to coordinate inspections and verify records.

The violations of marine loading regulations were typically for equipment maintenance (gas tight certification of the vessel) and component leaks.

District inspectors have found leaks above the current standard in components not directly associated with the loading of a regulated material. The current marine loading regulations do not apply gas leaks unless they are directly associated with the loading event. In many cases, the facility promptly corrected these leaks by making small adjustments to the equipment such as tightening the component.

V. IMPACTS

A. Emissions and Emission Reductions

Several factors affect the amount of potential emissions from marine vessels including but not limited to the type of cargo loaded, the configuration of the cargo tank, the prior cargo, whether the tank was cleaned, loading temperature, use of an inert blanketing system.

Emissions from vessels occur on a periodic basis. Although the daily average emissions are low, the emissions can be significant when particular loading event occurs or a series of loading events occur on the same day.

Additional testing would be required to better characterize the emissions. The follow table illustrates the potential emissions from a single loading event of currently unregulated cargos using emission factors and highest loaded amounts provided by industry.

Material	Emission Factor, lb/1000 bbl	Volume Loaded, 1000 barrels	Total Emissions, tons	Emission Reduction at 2 lb/1000 bbl, tons	Emission Reduction at 1 lb/1000 bbl, tons
Fuel oil	1.5	250	0.2	0.0	0.1
Fuel oil	4.7	250	0.6	0.3	0.5
Light Cycle Oil	34.1	250	4.3	4.0	4.1
Crude Oil Ballasting	17 to 180	200	2 to 18	1.5 to 17.8	1.6 to 17.9

The above table is based on a typical high volume event of 250,000 barrels for fuel oil and light cycle oil. Ballasting volume is based on a 10% capacity of a 2 million barrel vessel. If more than one loading event occurs on the same day, the emissions would be larger.

Analyses of the vent gases indicated significant concentrations of benzene, toluene, and xylene. Emissions from these compounds are estimated to be as high as 0.4 pounds per thousand barrels.

Additional information on procedures and frequency of housekeeping activities is needed to better characterize emissions. Although ballasting into tanks that carried a regulated cargo is required to be controlled at the terminal, the practice is not fully understood once the vessel leaves the terminal.

If incineration were used as the control strategy, there would be an increase in combustion products.

B. Economic Impacts

The economic impact from the implementation of further controls would affect the shipping industry. These impacts would include possible retrofit costs incurred by the terminals and vessel owners/operators as well as possible loss of revenue due to diversion of loading to other locations or other means of transport.

If the standard of 2 pounds per thousand barrels were lowered to 1 pound per thousand barrels, at least one facility may need to modify its control system. Additional study may be necessary to verify the efficiency of all the vapor recovery systems. When the rule was originally adopted in 1989, the facilities spent between $1 million to $30 million per terminal system. Ship modifications cost between $100,000 to $2 million for each vessel. The cost of the systems depended on the type of control system and the additional piping needed based on the system's configuration.

One facility is currently designed to handle only unregulated cargos. Further study would be needed to determine if adsorption equipment would properly function if abating heavier materials were required.

If terminal activity increases dramatically, additional vapor recovery systems may be required or operating fees may increase.

If additional loading events required control, operating costs for the vapor control equipment would increase. Examples include fuel for thermal oxidizers or carbon replacement. Maintenance for the vapor recovery equipment would likely increase and its life expectancy would likely decrease because of the added use.

Records show that multiple vessels do not load at the same time at the same terminal. Unless activity increases, abatement equipment currently used at the terminals could be used to control additional cargos. If a vessel had to wait for abatement equipment to be available, the cost would be approximately $70,000 to wait an additional day. Proper scheduling of vessels may eliminate these costs.

Additional information is required to better understand all of the costs associated with marine loading. Costs would include port fees, fuel costs, abatement equipment expenditures (activated carbon), and maintenance expenses.

VI. APPENDIX

Glossary

ARB: California Air Resources Board

BAAQMD: Bay Area Air Quality Management District

Ballasting: The loading of water or other liquid into a marine vessel's cargo tank to obtain proper stability.

bbl: barrel

Blending Stock: An organic liquid that can be blended into gasoline without and further processing. Examples: Naptha or MTBE

BTX concentration: the cumulative concentration of benzene, toluene, ethylbenzene, p/m xylene, and O-xylene

EPA: The United States Environmental Protection Agency

Gas Freeing: A process of opening the cargo tanks to the atmosphere after the hydrocarbons concentration reaches below the explosive level.

Housekeeping Activity: Any activity which would cause the release of organic compounds from a tank vessel into the atmosphere. These activities include but are not limited to tank washing, gas freeing, purging, or tank venting.

Inert Blanketing System: A system that injects a gas, usually diesel exhaust, to prevent air/vapor mixtures from reaching the explosive level.

Loading Event for 8-44: An incident or occurrence beginning with the connecting of marine terminal storage tanks to a tank vessel by means of piping or hoses, the transferring of organic liquid cargo from the storage tank into the tank vessel and ending with the disconnecting of the pipes or hoses.

Loading Event for 8-46: An incident or occurrence beginning with the connecting of a marine tank vessel to a marine tank vessel by means of pipes or hoses, the transferring of liquid cargo from one marine tank vessel to the other marine tank vessel and ending with the disconnecting of the pipes or hoses. In addition, emissions resulting from venting of precursor organic compounds within the District prior to or after a loading event are included in that loading event.

NMHC: Non-methane hydrocarbons

Organic Liquid (Current): For the purpose of this Rule, organic liquid is defined as all gasoline, gasoline blending stocks, aviation gas, and aviation fuel (JP-4 type).

Purging: A process of cleaning where cargo tanks are flushed with an inert gas to remove hydrocarbons.

SJV Crude: San Joaquin Valley crude oil

Marine Loading Testing Protocol

1. Objective:

1.1. Determination of total Non Methane Organic Carbon (NMOC) emissions from cargo ships on-loading exempt organics. Total NMOC emissions shall be determined based on sampling emissions during loading and analyzing the trends in the data collected. Sampling will be conducted in a manner having minimal impact on normal ship operations.

2. Procedure:

2.1. Whenever possible, emission sampling shall be conducted for the entire loading event, as determined to represent average emissions for a given product, which is filling the full depth of a tank or collection of tanks. The minimum acceptable sampling period is the final 50% of the loading event. Shipboard sample collection equipment will consist of the following:

2.1.1. Grounded Teflon sample line

2.1.2. Plastic bucket containing water at ambient temperature

2.1.3. Three (3) glass condensate knockouts

2.2. A Teflon sample line will be inserted into the shipboard emission point. (**Note:** Emission points will vary on each vessel. Verify the correct location with responsible vessel personnel). The sample line will lead directly into a plastic bucket containing condensate knockouts immersed in ambient temperature water. One of the glass condensate knockouts is to function as a water seal. The water seal knockout will be pre-charged with 100ml of distilled water. (**Note:** The sample line must be adequately grounded at both the bucket and sample collection ends).

2.3. After the bucket, the Teflon line will be routed to the pier and continue to the sample collection area. Test personnel will expeditiously remove the sample line at the conclusion of loading.

2.4. Testing Option #1 (preferred) – Mobile Test Van

2.4.1. The van is equipped with sample extracting pumps, and rack mounted instrumentation will be utilized in combination with evacuated canisters.

2.4.1.1. A continuous sample extracted from the ship's emission point by the van's pumps will be drawn into the sample collection area.

2.4.1.2. Vapor samples will be conditioned using iced knockouts to protect the van's instrumentation and plumbing from high level hydrocarbon saturation.

2.4.1.3. Sample flow will be metered and knockout condensate collected will be analyzed for determination of total hydrocarbons. Data generated by the van's rack mounted instrumentation will be continuously recorded by the data logging system. NMOC (or Total Organic Carbon (TOC) and methane), carbon dioxide, carbon monoxide and oxygen will be determined.

2.4.1.4. Prior to the van's iced knockouts a "T" will be inserted in the sample line and a portion of the sample will be directed into two parallel XonTech samplers. The XonTech samplers will slowly meter a controlled amount of emission samples into "Summa" type evacuated canisters.

2.4.1.5. For each test, up to six integrated Summa canister samples will be collected utilizing each XonTech sampler. One set of the parallel collected canisters will be under the control of California Air Resources Board (CARB) staff who will independently analyze the contents as specified in the CARB canister protocol. The set from the second XonTech will be submitted to the BAAQMD laboratory for analysis.

2.4.2. Testing Option #2 – Direct Sample, Canister Only

2.4.2.1. A continuous sample extracted from the ship's emission point by the van's pumps will be drawn into the sample collection area.

2.4.2.2. A small sample pump will operate in the sample collection area.

2.4.2.3. Prior to the pump, a portion of the sample will be directed to a sample line "T" and into two parallel XonTech samplers. The XonTech samplers will slowly meter a controlled amount of emission samples into "Summa" type evacuated canisters.

2.4.2.4. For each test, up to six integrated Summa canister samples will be collected utilizing each XonTech sampler. One set of the parallel collected canisters will be under the control of California Air Resources Board (CARB) staff who will independently analyze the contents as specified in the CARB canister protocol. The set from the second XonTech will be submitted to the BAAQMD laboratory for analysis.

3. Test Methodologies:

3.1. Organic Compounds, BAAQMD ST-7, Continuous Sampling

3.2. Oxygen, BAAQMD ST-14, Continuous Sampling

3.3. Carbon Dioxide, BAAQMD ST-5, Continuous Sampling

3.4. Carbon Monoxide, BAAQMD ST-6, Continuous Sampling

3.5. Evacuated Canisters (SUMMA Canisters), CARB Protocol for Collecting Canister Samples from Cargo Ships On-loading Exempt Organics

3.6. Bulk and Marine Loading Terminals Vapor Recovery Units, BAAQMD ST-34

4. Safety Procedures:

4.1. Test personnel will strictly observe all terminal and shipboard safety procedures. Test personnel will comply with all facility requirements regarding visitors performing work at the facility. Correct personal protective equipment will be worn when in the terminal area.

4.2. Flowing vapors can create a buildup of static electricity. The Teflon sample line must be adequately grounded at both the bucket end of the hose and at the sample collection point (Mobil Van or sample canister).

4.3. Test personnel must understand that sampling emissions of flammable materials requires a maximum degree of safety. Test personnel must remain alert and observe all applicable safety procedures for operation of sampling equipment in areas where loading of flammable materials is occurring.

5. Testing Data and Variables:

5.1. Primary data and variables to be gathered by the source test team are those necessary to calculate the NMOC emissions and document basic test parameters. These data are:

5.1.1. Vessel name and registry

5.1.2. Vessel type (tankship, tankbarge)

5.1.3. Inert Gas System Type (generator, nitrogen, flue gas, etc.)

5.1.4. Vapor (vent line) configuration (manifold / non-manifold)

5.1.5. Prior load history by tank

5.1.6. Prior tank ballasting or housekeeping activities (type & method) including tank washing, gas freeing, purging, or tank venting

5.1.7. Product loaded (type, temperature, total load, liquid sample)

5.1.8. Product loading rate

5.1.9. Ambient temperature (during load)

5.1.10. Times of loading start and sampling start

5.1.11. Times when integrated Summa canister samples were taken

5.1.12. Times of loading completed and sampling completed

5.2. Test parameters that are not necessary for the calculation of the NMOC emissions but may aid in the analysis of the final test results are listed below. The source test team will not gather them as a component of the test. These parameters are:

5.2.1. Tank configurations (L, W, D)

5.2.2. Inert Gas System (Fuel Specification, Exhaust Composition)

5.2.3. Temperature of tank vapor space

5.2.4. Pressurization of tank vapor space (Continuous reading if possible)

5.2.5. Verification of any product in tanks remaining from previous loading(s)

5.2.6. Product loaded (Flash, RVP)

5.2.7. Product Loading Plan

5.2.8. Percent sulfur in product

5.2.9. Positive confirmation of all vapor vent valves positions

5.2.10. Source test of existing vapor space

5.2.11. Time and description of any vapor (vent) connection operational change

5.2.12. Time and description of any product transfer operational change (switching tanks, adding new tanks, stopping tank load, etc.)

Marine Loading Testing Checklist

Date	Terminal		Start of Loading AM PM
Vessel			
Vessel Name & Registry			
Vessel Type	☐ Tankship ☐ Tankbarge ☐ Other (specify):________________		
Inert Gas System	☐ Generator ☐ Nitrogen ☐ Other (specify):__________________		
Vapor vent line configuration	☐ Manifold ☐ Non-manifold		
Vessel History			
Prior Load History by Tank:			
Prior Tank ballasting or housekeeping activities (type and method): (Including tank washing, gas freeing, purging or tank venting)			
Product			
Product Type		Total Load	
Product Temp	°F °C	Ambient Temp:	°F °C
Loading Rate		Liquid Sample (Y/N)	
Sampling			
Sampling Equipment (Check off)	☐ Grounded Teflon Sample Line ☐ Plastic Bucket with water ☐ Three (3) Glass Condensate Knockouts		
Test Van available ☐ Yes ☐ No (If Yes, collect continuous samples and analyze)			
Start of Sampling	AM PM		

1. Insert grounded Teflon sample line into shipboard emission point.
2. Lead sample line into plastic bucket with condensate knockout immersed in ambient temperature water.
3. Collect continuous samples at the Test Van, if available.
4. Collect two pairs of six Summa canister samples from two parallel XonTech samplers.
5. Remove sample line at conclusion of loading.

Time of Summa canister samples	AM PM	End of Sampling	AM PM
Sampling by: ______________________		End of Loading	AM PM

References

1) 8-31 Marine Emissions Study Final Report, 8-31 Technical Advisory Committee, December 1978

2) The Flammability Hazards Associated with the Handling, Storage and Carriage of Residual Fuel Oils, Oil Companies International Marine Forum, December 1989

3) Report of the Emissions Testing of the Vent Stacks Serving the Chevron Tanker Oregon During Loading Operations at Chevron's El Segundo, CA Terminal, Radian Corporation, March 1994

4) Final Report: Rule 1142 Compliance Test Methodology, Western States Petroleum Association, Eichleay Engineers Inc. of California, Project 4491, June 1994

5) Source Test Results of Loading Light Cycle Oil onto the Honshu Spirit on May 9, 1995 for Arco Pipeline in Long Beach, CA, Almega Environmental & Technical Services, Inc., Report C7344, June 1995

6) Environmental Contaminants Encyclopedia Fuel Oil Number 6 Entry, Roy J. Irwin, et. al., National Park Service, Water Resources Division, Water Operations Branch, July 1, 1997

7) No.6 Fuel Oil Material Safety Data Sheet, Amerada Hess Corporation, MSDS No. 9907, Revision Date February 28, 2001

8) Source Test Results of Loading Flash Distillate onto the Seabridge vessel at the Martinez Refining Company November 1 & 2, 2001, Bay Area Air Quality Management District, Report 02103, December 2001

9) Source Test Results of Loading #2 Diesel Oil at IMTT on May 22, 2002, Bay Area Air Quality Management District, Report 02175, June 2002

10) Stationary Source Test for Air Kinetics at BP/ARCO Fuel Transfer Barge in Long Beach, CA, Eichleay Engineers Inc. of California, Project #30386, July 1, 2002

11) Source Test Results of Loading High Sulfur Fuel Oil onto the Ambermar vessel at Martinez Shore Terminals on June 18, 2002, Bay Area Air Quality Management District, Report 02199, July 2002

12) Source Test Results of Loading Fuel Oil #6 onto the Foss 248-PS vessel at Phillips 66 Company on June 11, 2002, Bay Area Air Quality Management District, Report 02200, July 2002

13) Source Test Results of Loading Jet Fuel #8 onto the “Samuel L. Cobb” vessel at Selby Shore Terminals on October 22, 2002, Bay Area Air Quality Management District, Report 030701, November 2002

14) Source Test Results of Loading Cutter Stock (TKN) into the Crowley Barge No. 450-11 at the Chevron Richmond Long Wharf on October 9, 2001, Fuel and Marine Marketing LLC, Report 082102